directed to an etchant gas consisting of a *hydrogen-free fluorocarbon gas*, an oxygen-containing gas and a optional carrier gas. Support for the claimed hydrogen-free etch gas can be found in the specification as follows:

> Especially good selectivity of oxide to nitride can be obtained when the etch gas is free of hydrogen and/or nitrogen. (Emphasis added, page 17, lines 19-20.)

> The fluorocarbon is preferably hydrogen-free and may comprise at least one C_xF_y gas... (Emphasis added, page 18, lines 20-21.)

> According to the invention, oxygen is added in an amount effective to control the etch rate selectivity of the etching gas chemistry. That is, the oxygen is effective to prevent etch stop by reacting with polymer at the bottom of the etched openings. The advantageous effects of the invention can be achieved by supplying the oxygen reactant and fluorocarbon reactant to plasma etching reactor at a flow rate ratio of oxygen reactant to fluorocarbon reactant of 1.5 or less. For selective etching of BPSG in a medium density plasma etch reactor, the flow rate ratio of oxygen reactant to fluorocarbon reactant is preferably 0.5 to 1.2...[t]he etching gas mixture may optionally include other gases and/or an inert carrier gas such as argon (Ar), helium (He), neon (Ne), krypton (Kr), xenon (Xe) and mixtures thereof. (Emphasis added, page 18, line 12 through page 19, line 3.)

From the foregoing excerpts from the specification, Applicants respectfully submit that the subject matter of Claims 23-25 does not introduce any new matter. Thus, this rejection should be withdrawn.

Claims 1-5, 9-12 and 14-25 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 6,174,451 to Hung et al. ("Hung") in view of U.S. Patent No. 6,074,959 to Wang et al. ("Wang"). The reasons for this rejection are set forth in numbered paragraph 4, on pages 2-6 of the Official Action. In particular, the

Official Action alleges that (1) Wang discloses the use of an oxygen-containing gas with a fluorocarbon main etchant gas to etch an oxide (dielectric) layer and (2) it would have been obvious to modify the C_4F_6-based oxide etch of Hung to include the oxygen-containing gases of Wang. This rejection is respectfully traversed for the following reasons.

Reconsideration of the rejection is requested in view of the following legal precedent regarding rejections based on a combination of prior art references. First, in In re Vaeck, 20 USPQ2d 1438, 1442 (Fed. Cir. 1991), the court stated the following regarding a proper §103 rejection:

> "Where claimed subject matter has been rejected as obvious in view of a combination of prior art references, a proper analysis under §103 requires, *inter alia*, consideration of two factors: (1) whether the prior art would have suggested to those of ordinary skill in the art that they should ... carry out the claimed process; and (2) whether the prior art would have also revealed that in so making or carrying out, those of ordinary skill would have a reasonable expectation of success [citation omitted]. Both the suggestion and the reasonable expectation of success must be found in the prior art, not in applicant's disclosure." (Vaeck at 1442.)

In addition to the above, In re Imperato, 179 USPQ 730 (CCPA 1973) set forth the following regarding a proper combination of references:

> "With regard to the principal rejection, we agree that *combining* of Schaefer with that of Johnson or Amberg *would give the beneficial result observed by appellant*. However, the mere fact that those disclosures *can* be combined *does not make the combination obvious unless* the art also contains *something to suggest the desirability* of the combination." (Emphasis added) (Imperato at 732).

Claim 1 is directed to a method of *etching a dielectric layer with selectivity to an underlying stop layer*, comprising (a) supporting a semiconductor substrate in a plasma etch

reactor, the substrate including a dielectric layer over a stop layer; (b) supplying an etchant gas to the plasma etch chamber; and (c) etching openings in the dielectric layer by energizing the etchant gas into a plasma state, the etchant gas comprising a *hydrogen-free* fluorocarbon gas represented by C_xF_y gas wherein $y/x \leq 1.5$, an *oxygen-containing* gas and optional carrier gas. As set forth below, the combination of references fails to teach or reasonably suggest all of the claim limitations. Further, persons of ordinary skill in the art would not have had the requisite reasonable expectation of success when combining the references in the manner suggested in the Official Action.

Hung Teaches Away From Using a Hydrogen-Free Gas

Hung discloses an oxide etching process for selectively etching oxide over a feature having a non-oxide composition in a high-density plasma reactor using unsaturated fluorocarbons with a low but *finite hydrogen content* (see abstract, Column 5, lines 47-56 and Column 11, lines 1-10). Specifically, Hung uses a two-step oxide etch in order to obtain the desired selectivity to an underlying nitride layer (See Column 8, lines 26-34). As noted by the Examiner on pages 3 and 8-9 of the Official Action, in a main etch recipe Hung uses C_4H_6 (with no CH_2F_2) to etch the entire oxide layer (See Column 10, lines 21-24). However, because the main etch does not break through the oxide layer, the *main etch is not selective* to the underlying nitride as required by Claim 1.

Hung does not etch through the oxide to the underlying nitride layer until the main etch gas is replaced with an over etch gas. As disclosed by Hung, without the polymerizing CH_2F_2 (used in the over etch recipe) significant nitride corner faceting is observed (See column 10, lines 29-34). Thus, the over etch recipe of Hung is intended to circumvent the

poor nitride selectivity of the main etch recipe (See column 10, lines 32-34). While the hydrogen-free main oxide etch of Hung can be used to etch the entire oxide layer, the main oxide etch is stopped before reaching the underlying layer and thus is not an oxide etch having selectivity to an underlying stop layer. Moreover, Hung teaches away from using a hydrogen-free gas to etch *a dielectric layer with selectivity to an underlying stop layer,* since Hung uses a hydrogen-containing gas for the over etch, *i.e.*, Hung uses the heavily polymerizing fluorocarbon etch gas (CH_2F_2) to increase the nitride selectivity.

Hung Teaches Away From Using Oxygen

Furthermore, in contrast to the claimed method, Hung does not disclose or suggest a method of etching a dielectric layer with selectivity to an underlying stop layer wherein the etchant gas comprises an *oxygen-containing* gas. Hung adds "a more heavily polymerizing fluorocarbon gas" in order to obtain nitride selectivity (See column 8, lines 13-16). Hung's over etch to obtain "a complete etch without producing excessive nitride faceting" uses an etchant gas which is an oxygen-free gas. Hung specifically states that the *"oxygen destroys any nitride selectivity"* (Emphasis added, see column 10, line 51). Furthermore, Hung uses oxygen to *etch the nitride*, i.e., Hung uses a fluorocarbon such as CH_2F_2, Ar *and oxygen* (see column 10, lines 43-51). Thus, Hung *teaches away* from using an oxygen-containing gas to etch a dielectric layer with selectivity to an underlying nitride layer.

Wang's Oxygen Gas is Incompatible with Hung's Oxygen-Free Gas

The Official Action cited Wang for disclosing the use of oxygen gas with the main-etchant gas. In particular, the Official Action cites a portion of Wang stating that "[t]he above processes can be modified by the addition of carbon monoxide, nitrogen, or oxygen,

all of which are known to enhance selectivity and increase the etch stop margin" (column 10, lines 23-26). Although Wang mentions carbon monoxide and oxygen in column 10 thereof, one of ordinary skill in the art would not have been led to add such gases to the over etch gas of Hung in view of Hung's teaching that "oxygen destroys any nitride selectivity" (column 10, line 51 of Hung).

Lack of Motivation and No Reasonable Expectation of Success

As discussed above, the Official Action has not set forth a tenable basis establishing the requisite motivation to combine Wang with Hung in a manner that would produce the claimed method. Furthermore, the Official Action does not set forth an explanation as to why one of ordinary skill in the art would have had a reasonable expectation of success in combining Hung and Wang as suggested in the Official Action. Given Hung's teaching to use a hydrogen-containing oxygen-free gas, it is submitted that a person of ordinary skill in the art would not have been led to use a hydrogen-free, oxygen-containing over etch gas to etch openings in the dielectric layer of Hung.

In view of the foregoing, Applicants respectfully submit that Claim 1 and all the claims dependent therefrom are clearly patentable over the combination of Hung and Wang.

Claims 6-8 and 13 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Hung and Wang in further view of U.S. Patent No. 6,228,438 to Schmitt ("Schmitt"). The reasons for the rejection are set forth in numbered paragraph 4, on pages 7-8 of the Official Action. The Official Action alleges that Schmitt discloses a dual frequency capacitively coupled plasma reactor including an upper showerhead electrode and a bottom electrode (see column 8, lines 1-10) and that it would have been obvious to

modify the etch process of Hung and Wang to include other commercially available plasma etch reactors. This rejection is respectfully traversed.

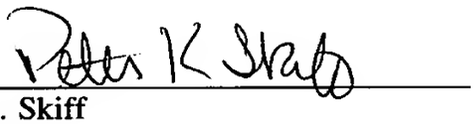
Claims 6-8 and 13 depend from Claim 1 and thus are patentable over the cited references for at least the reasons that Claim 1 is patentable over Hung and Wang.

It is submitted that the differences between the claimed subject matter and the prior art are such that the claimed subject matter, as a whole, would not have been obvious at the time the invention was made to a person having ordinary skill in the art.

In view of the foregoing, it is submitted that the present application is in condition for allowance and such action is earnestly solicited.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

By: 

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